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(54) Title: ANTI-CRUSH WORKER-SAFETY HARD JACKET (57) Abstract An improved rigid safety-vest structure intended for general use in hazardous-construction environments, such as encountered by trench and tunnel workers. Sudden cave-in situations are said by the U.S. Federal agency O.S.H.A. to tragically take many lives annually to insidious suffocation, attributable to simple impairment of a workers' upper-abodmen/thorax region by suddenly surrounding cave-in earth. The notion of the HardJacket™ being to prevent these fatalities, by providing the worker with a lightweight aerated upper-torso safety-vest within which an earth-immobilized worker can maintain their vital breathing action, while efforts are being made to bodily extricate them. The disclosure includes a three-paneled frontally opening self-donning structure fabricated with an interlaced metal truss-structure, preferably enveloped in a bright-colored aerating nylon-fabric; plus a generic-variant embodiment, formed of inner and outer rigid-skins separated by a rigid foam-core interior. All iterations employ a comfortably flexile shoulder suspension arrangement, and may be provided with optional backside rollers, enabling a worker to more easily scoot beneath an overhanging ledge or vehicle.		

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INVENTION ENTITLED: " Anti-crush Worker-safety Hardjacket "

FIRM ASSISTING DOCUMENTATION & APPLICANT'S DOCKET REF.NR.: Inventech, VH/892032

PRIOR APPLICANT PTO/DISCLOSURES: Several PTO/Disclosure Documents, filed as follow-
Serial-nr's.: #398,651 filed- 22/May/96; #402,061 filed- 11/June/96; #403,120 filed-
29/July/96; #405,139 filed- 16/Aug./96; #422,739 filed- 06/Aug/97; and U.S.Provisional-
patent Application #043,358 filed- 10/April/97; plus, "HardJacket" Trademark-application
#75/402,208 filed- 01/Dec./97. (Note: see accompanying IDS-packet for photocopies)

TENTATIVE U.S.CLASS: Utility; for Examiner's determination. **NUMBER OF DRAWINGS:** one

NUMBER OF PATENT CLAIMS: Independent-3; Dependent-17, Multipul-dep.- 0.

ATTACHED ITEMS: Oath & Declaration Petition w/small-entlty & Status-pledge statements.

RELATED-ART IDS(Info.Disclosure Statement) CITED BY APPLICANT:

See accompanying IDS-forms & attached Patent-search copies, in compliance with
PTO/#IC-10 regarding known related-art material; for Examiner's review.

I.) BACKGROUND OF THE INVENTION:

FIELD OF INVENTION:

This invention relates to protective gear for the human torso; and more specifically,
it relates to those class of protective garments serving to obviate crushing loads imposed
upon the wearer's upper-abdomen/thorax region from causing suffocating impairment of
their breathing.

PRIOR PATENT-ART:

This disclosure is parented by U.S.Provisional-Pat.Application #043,358 (filed:
10/April/97) solely by inventor hereof; plus, background research discovery provides other
prior patent-art regarded as germane. Chronologically for example, U.S.Pat.#989,530

time; thereby failing to fulfill industrial need for an anti-crush safety garment like article.

In U.S. Patents #4,425,667 (filed: 1/1984) and #5,524,641 (filed: 11/1994) are shown similar "protective-vest apparatus", both of which teach protective paneling which extends up and over the shoulders for suspension from the body. The earlier embodiment being devised particularly for wearing by motorcyclists, watercraft, snowmobile, and rodeo-riders; while the latter embodiment more addresses a need among intense contact-sports, such as football and hockey players. The respective apparatus both address the purpose of absorbing and dispersing otherwise traumatic impacts from objects to the torso; the earlier embodiment via more traditional materials such as contour molded 1/8-inch gauge ABS (acrylonitrile-butadiene-styrene)-plastic panels internally-backed by 1/2-inch gauge closed-cell foam such as ENSOLITE®. The latter embodiment differing particularly in that it sets forth a more high-tech paneling construction, such as myriad honeycomb or myriad geodesic-dome structural entities extending out to form the paneling. However, neither embodiment anticipates the need to protect a wearer from a crushing-load imposed from opposite sides of the body.

Finally, in U.S. Pat. #5,306,557 (filed: 2/1992) is shown best in Fig.-8 revealing a type of "composite hard-body tactical-armor" which is shown packaged much as a vest fitting close to the wearer's body without significant allowance for air-circulation and chest expansion. Because the structure is substantially flexible in nature, the illustration indicates the wearer can avulse a hook-&-loop fastened overlapping side-panel and likewise one of the portions extending up and over the shoulders, in order to actually slip the protective garment on laterally. However, once so donned, the vest offers no apparent functional resistance to withstanding a crushing load imposed upon opposite sides (or upon all sides) of the torso.

PREVAILING PROBLEM:

Because there is no commercially acceptable product presently available capable of satisfying the needs of construction-workers in the effective manner of the usually U.S. Federal OSHA/safety-standard mandated manner, such as the now familiar hardhat and steel-toed shoes, the news-media all too often bares tragic testimonial to events, where a

1 cave-in victim could have been saved. For example, a pipe-laying trench-worker can be
wearing OSHA/safety-equipment, which paradoxically, does nothing really to help the
victim trapped by an earthen-trench sidewall collapsing upon them; usually enveloping
and immobilizing their arms, shoulders, and neck. Cave-in victims typically cannot cry-
5 out for help, owing the soil loading upon their chest and back has effectively knocked the
air out of them, in a quiet insidious way rendering them unable to further inhale and
exhale. And even if discovered in time, coworkers may not realize the critical few
seconds remaining in which to try (usually in vain) to save their coworker, often believing
that merely freeing the victim's face to the air will enable them to breathe. This plight has
10 been rightfully termed "insidious compression-load suffocation", in as much as the victim
may actually appear alright, eyes wide-open, mouthing in utter silence a final frantic
something like... "help me, -I can't breath!", then shortly thereafter blacking-out from
oxygen-depletion. Because even if they could exhale to take another breath, "quick-sand"
like soil can promptly fill-in preventing re-expanding their upper-abdomen/thorax (action
15 required in breathing). Whereupon, a natural panicky-trama sets-in, the victim tries to
execute a last round succession of rapid mini-inhalations with all their might against the
impacted earth; which is just to much, and they finally give-up from exhaustion.
Meanwhile, valiant efforts to dig the victim out, generally results in further compacting the
soil still tighter against the victim's torso; and, may cause still further cave-in of the
20 adjoining trench wall region; all in all, compounding the problematical scenario. By the
time professional aid can arrive, it is generally simply to late to extricate the victim for
timely resuscitation. Therefore, in full consideration of the preceding patent review,
there is determined a need for an improved form of device to which these patents have
been largely addressed. The instant inventor hereof believes their newly improved crush
25 protective vest device, commercially referred to as the HARDJACKET™, currently being
developed for production under auspices of the Barker/R&D-Group(LLP) exhibits certain
advantages as shall be revealed in the subsequent portion of this instant disclosure.

II.) SUMMARY OF THE INVENTION:

A.) In view of the foregoing discussion about the earlier invention art, and the prevailing problem, -the object of this disclosure is to provide a commercially viable solution addressing continuing need for a truly wearable "user friendly" product, which can comfortably provide reasonable physical protection for a person working where some manner of potential cave-in hazard exists. It is therefore important to make it pellucid to others interested in this art, that the object of this invention is to provide a circumferentially rigid underarm shoulder suspended torso jacket, so improved in practical terms over the preceding prior-art inventions, as to comfortably protect the wearer's body generally extending between region of the diaphragm or upper-abdomen, and upward covering the upper-chest or thorax; and necessarily, those directly opposite back regions thereof. This upper-abdomen/thorax region is the portion of the human-anatomy considered vital to performing the air-breathing process, provided one's cooperative throat/mouth/nostril region is clear of occlusion to passage of air, and the soil is prevented from exerting a constricting compressive inward force upon the victim's torso, the victim has a very good chance of surviving and going back to work the same day. Most back-hoe'd trenches for foundations and pipe-laying are under 5-feet in vertical-depth, thus the actual weight borne upon a victim's torso can be about 750/lbs-1,200/lbs. Federal-law requires installation of reinforcement-shoring in trenches over this height; the inventor hereof advising wearing of a HARDJACKET™ in trenches over 4-feet deep, but that such a protective device is no substitute for side-shorings.

In still other instances, a sea-rescue marine, may be crushed between two boats in rough-sea, a steel-worker may be threatened while unloading beams, a mill-worker while handling logs, a demolition-worker is caught between crumbling structure, or a geologist is pinned under a collapsed overhang. These are all tasks where with foresight, and with impending liability driven sales, these workers should be wearing a HARDJACKET™ constructed to enable possible survival in a situation where otherwise, the odds for survival are dubious at best!

Accordingly, the HARDJACKET™ invention herein generally disclosed is carefully

configured so as to be entirely flexible relative to shoulder movement; -that is, there is no rigid portion of the structure extending up and over the shoulders which could hinder the physical activity involved in sustaining a strenuous shoveling activity for example. Therein was the challenge, to provide a product which intrudes minimally with work-tasks, yet which is capable of sustaining an impact from a fallen tree-branch, or the weight of a collapsing framework encountered during construction or repairs. Thus, by constructing the invention without a rigid closing above the shoulders, it actually enables a worker otherwise possibly caught under a heavy collapsed-beam, a chance to escape from the HARDJACKET™ by casting the flexile shoulder-straps aside (or otherwise, be extricated by rescuers, who may have access to slice the shoulder-straps away) then squirm upwardly out of the possibly ensnared protective HARDJACKET™. The compressive-rigidity strength of the invention has been prototype tested to well withstand a 3,000/lb load, imposed both front-to-rear and side-to-side, without appreciable inward deflection (¼-inch max. diametrically). It is planned the HARDJACKET™ shall be made available in the four basic sizes of: small, medium, large, extra-large; -of unisex design (not gender specific).

B.) Another object of this invention disclosure is to set forth a preferably 3-piece personal-safety apparatus assembly capable of protecting wearer's upper-abdomen/thorax region from compression-loads (that is, loads sustained from opposite sides of the torso which are exerted in a radial direction approximately right-angles to the spinal-column); the first/protective-panel not intimately but proximally interfacing wearer's back region, the second/protective-panel hingedly dependent from the first/protective-panel while proximally interfacing wearer's left-front upper-abdomen/thorax and left underarm region; the third/protective-panel also hingedly dependent from the first/protective-panel while proximally interfacing wearer's right-front upper-abdomen/thorax and right underarm region.

A comfortably flexile shoulder-suspension is preferably comprised of two woven-straps, one extending over the wearer's left-shoulder, the other woven-strap extending over the right-shoulder; whereby the separate woven-straps are secured down frontally to their respective left and right protective-panel members. An alternate shoulder-suspension

1 device is comprised of a fabric-like one-piece shoulder garment, having a front-medial
left from right separation; the aftward left-portion of which extends up from the left upper
portion of the mentioned first/protective-panel, and up over the wearer's left-shoulder and
down where it is secured to the second/protective-panel. Likewise, the aftward right-
5 portion of which extends up from the right upper region of the first/protective-panel and
over the wearer's right-shoulder down securely to the third/protective-panel member's
upper region.

An alternate generic-variant of the above structure comprises a two-piece
HARDJACKET™ personal-safety apparatus assembly, comprised of rigid front and rigid rear
10 protective-panels not intimately but proximally interfacing the wearer's front and back
region; the rigid front/protective-panel hingedly dependent at one side from the rigid
back/protective-panel, and employing essentially the same configuration of shoulder-
suspension outlined above.

C.) Another object of this invention disclosure is to set forth the two or three
15 piece personal-safety HARDJACKET™ apparatus identified in paragraphs-A&B, either of
which being capable of protecting wearer's upper-abdomen/thorax region from heavy
compression-loads as based upon two structurally different types of construction, either of
which being under ten-pounds in overall-weight.

A type-FTE(fabricated truss elements) form of construction appears almost aircraft
20 fuselage like in embodiment, as it is comprised of plural intersecting open truss-work like
preferably metal structural elements, generally unitized via oven-brazing. The resulting
assemblage is inherently open to the free circulation of ambient-air, which is important to
the wearer's comfort under most conditions; although it is preferred that the assemblage
be covered over with an external slipover high-identity garment of brightly-colored
25 loosely-woven fabric serving to generally block dirt from entering the interstitial region
between the protective assembly and the wearer.

In contrast, an alternate type-CPS(composite polymer sandwich) form of
embodiment appears relatively straamlined in clamshell construction, as it is comprised of
29 tough polymer-resin materials such as epoxy-resin impregnated KEVLAR® (a nylon-based

1 aramid-fibercloth) laminant outer and inner facing substrates intimately united via a rigid
light-weight foam-core (or equivalent honeycomb or geodesic interior core) uniting
portion. These protective-panels (in either two or three section arrangements) are not
inherently open to free passage of ambient-air, thus may include a pattern layout design
5 of venting through-holes.

The third embodiment option is to combine the CPS and FET types of construction,
for example providing a back/protective-panel in CPS with a single or dual
front/protective-panel in FET; whereby owing to the very open FET frontal structure, the
back CPS panel may be substantially imperforate; -or arranged vice versa, CPS in front,
10 FET at rear. Since either type of construction can be made sufficiently rigid as to
withstand significant crushing loads, the inventor hereof believes it is largely up to the
engineering-designer to determine the particular manner of construction most suitable for
their workplace-task application. The possible advantage for the FET-type construction
executed in aircraft-grade aluminum-alloy, resides in it's non-aging quality after being
15 exposed to the sun's ultraviolet-rays for years.

D.) Another object of this invention disclosure is to set forth a girth-retention
device suitable for either the 2-piece or 3-piece personal-safety HARDJACKET™ apparatus
identified in paragraphs-A&B, and types of construction outlined in paragraph-C; whereby
a wearer manually guides the distally opposite circumferential ends of the HARDJACKET™
20 securely together at the frontal vertical median where the vertical margins of the left and
right protective-panels converge; -thereby securing the HARDJACKET™ to it's wearer until
removal be desired. Although a number of suitable latching devices are known, the two
girth-retention devices presently presented herein are:

a.) a plural arrangement of incrementally spaced apart vertical adjustment-bores of
25 a common size rigidly mounted proximal the vertical-margin of the second/protective-
panel. An opposite interposing vertical key-bore of the same common size, is rigidly
mounted proximal the adjoining vertical-margin of the third/protective-panel; whereby the
second and third protective-panels are therefore able to be interposed one to the other
29 until the most suitable girth sizing fitment is realized. Then, a vertical latch-pin is inserted

1 down through both the key-bore and one of the selected adjustment-bores, thereby
attaining a positive link-up of the second and third protective-panels, while cooperatively
coupled with the first/protective-panel. The latch-pin is preferably of a substantially
conventional self-locking so-called bayonet-type clevis-pin, employing a spring-loaded
5 coaxial secondary-pin which abaxially-biases an interference-ball, preventing extraction of
the latch-pin from the bore until the secondary-pin is shifted sufficiently enabling the
interference-ball to momentarily radially-retract into the shank of the latch-pin, whereby
the latch-pin may be withdrawn from the selected bore; or, some alternate girth-
retention device of choice.

10 b.) comprising a vertical-tongue formed upon one of the two circumferentially distal
ends of the HARDJACKET™, and a corresponding vertical-groove formed upon the opposite
distal end thereof; the aggregate tongue-&-groove members being held intimately engaged
via an overlapping arrangement of a substantially conventional belt-&-buckle arrangement,
or a substantially conventional hook-&-loop fastener arrangement.

15 III.) DESCRIPTION OF THE PREFERRED EMBODIMENT DRAWINGS:

The foregoing and still other objects of this invention will become fully apparent,
along with various advantages and features of novelty residing in the present
embodiments, from study of the following description of the variant generic species
embodiments and study of the ensuing description of these embodiments. Wherein indicia
20 of reference are shown to match related matter stated in the text, as well as the Claims
section annexed hereto; and accordingly, a better understanding of the invention and the
variant uses is intended, by reference to the drawings, which are considered as primarily
exemplary and not to be therefore construed as restrictive in nature; wherein:

Figure-1A, is a 3/4-front pictorial-view of an exemplified clean-lined appearing
25 embodiment for a two protective-panel version of the invention employing CPS-type
construction, including phantom outline of a human-form thereto for reference as to the
flexile shoulder suspension arrangement employed therewith;

Figure-1B, is a 3/4-rear pictorial-view thereof, favoring the wearers left side;

Figure-2, is a slightly enlarged cross-sectional top/plan-view thereof, referenced 2:2 in Fig.-1A, and demonstrating the cooperative relationship of the dual protective-panel embodiment in installed condition encircling a wearer's body, including a phantom-outline indication of frontal protective-panel hinging action;

Figure-3, is a 6X-enlarged cross-section thereof, referenced 3:3 in Fig.-2;

Figure-4A, is a 3/4-front pictorial-view of an exemplified embodiment for a three protective-panel version of the invention employing FTE-type construction, including phantom outline of a human-form thereto for reference as to a flexile shoulder suspension arrangement therewith;

Figure-4B, is slightly enlarged a 3/4-rear pictorial-view thereof, favoring the wearers left side;

Figure-5, is a slightly enlarged cross-sectional top/plan-view thereof, reference 5:5 in Fig.-4A, and demonstrating the cooperative relationship of the three protective-panel embodiment in installed condition encircling a wearer's body, including a phantom-outline indication of both frontal protective-panels hinging action, as well as their girth-adjustment geometry;

Figure-6A, is a frontal-view according to Fig.-4A, showing an alternate shoulder suspension arrangement for the invention;

Figure-6B, is a rear-view thereof.

IV.) ITEMIZED NOMENCLATURE REFERENCES:

- 10'/10"- overall hardjacket invention (CPS-type/FTE-type)
- 11,11'/11"- front/protective-panel (2-piece model / 3-piece model: left/right)
- 12,12'- rear/protective-panel (2-piece embodiment / 3-piece embodiment)
- 13/13',13"- panel inner-skin substrate (fnt.panel/rear panel), butting-flange
- 14/14',14"- panel outer-skin substrate (fnt.panel/rear panel), butting-flange
- 15/15'- panel core substrate (fnt.panel/rear panel)
- 16- trailing hinge segment (fnt.panel)
- 17- leading hinge segment (rear panel)
- 18- hinge-pin axis (common)

- 19,19'/19"- integral strap-moorings, strap anchor-pin (front/rear)
- 20- ventilation apertures
- 21- vertical tongue
- 22/22'- vertical groove (inside/outside)
- 23,23'- right shoulder-strap, quick-release buckle
- 24,24'- left shoulder-strap, quick-release buckle
- 25,25'- anchor-strap (rear protective-panel), wrap-around portion
- 26,26'- quick-release buckle & strap (front protective-panel), wrap-around portion
- 27- FTE rear armature
- 28,28'- FTE front armature (left/right)
- 29,29'- FTE rear horizontal-ribs (upper/lower)
- 30/30'- FTE front-left horizontal-ribs (upper/lower)
- 31/31'- FTE front-right horizontal-ribs (upper/lower)
- 32,32'- key-bore, latch-pin
- 33,33'/33"- vertical-axis of adjustment-bores
- 34/34'- front-left FTE main-truss members (leading/trailing)
- 35/35'- front-right FTE main-truss members (leading/trailing)
- 36/36'- rear-left FTE main-truss members (leading/trailing)
- 37/37'- rear-right FTE main-truss members (leading/trailing)
- 38/38'- front vertical-stiffener members (left/right)
- 39,39'/39"- FTE vertical-ribs (rear, front-left/front-right)
- 40- aeration/lightening-holes
- 41/41'- vertical hinge-axis (left/right)
- 42/42'- rear vertical-stiffener members (left/right)
- 43,43'/43"- shoulder hanging garment (rear, front: left/right)
- 44,44'/44"- zipper, plus two alternate ½-zipper portions (2nd / 3rd)
- 45,45'- strap mooring-slots, soft-edging
- 46- interstitial spacing
- 47,47'/47"- upper-abdomen/thorax region, human wearer (front-aspect/rear-aspect)

V.) DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Initial reference is given by way of Fig's.-1A/1B, wherein is exhibited the considered most clean-lined embodiment of the overall invention 10', which in this iteration employs a 2-piece CPS-type protective-paneling based upon substantially conventional known composite polymer sandwich type construction; providing a rigid albeit light-weight component. The front view aspect Fig.-1A exhibits front-half protective-panel 11, while Fig.-1B exhibits the cooperating rear-half protective-panel 12, joined at one side by a preferably integrally-formed interposed-hinge arrangement comprised of trailing front hinge segments 13 and rear leading hinge segments 14, joined by hinge-pin 15. Both panels 11 and 12 preferably employ high-strength Kevlar®(epoxy resin impregnated) laminants for both the inner substrate skin 14 and outer substrate skin 15, which are united via a core 16 made of a light-weight compression-resistive substrate. The essential function of core 16 being to space the respective protective-panel's external skins 14 and 15 sufficiently apart (materials remaining the same, the greater the spacing, the more rigid the part) as to achieve the amount of protective-panel resistance to bending needed to rigidly sustain a CLR(crushing-load rating) of generally to 1½-ton(3,000/lbs) applied from any azimuth direction relative to it's standing wearer.

In a much as a wearer of the HARDJACKET™ may be found knocked from standing or kneeling, to a prone (or supine) position, a more appropriate term than "azimuth" is required when referring to "a crushing-load squeezing-in from opposite sides" at a direction approximately radial to wearer's spinal-column. Hence, the technical designation of: "CLR: 1.5T/SCR" (spinal-column radian) is more appropriate to define that the HARDJACKET™ can for example withstand a cave-in loading of 3,000-lbs.S(sustained) and perhaps to 5,000-lbs.SI(sudden-impact). Presently, no federal OSHA strength-standards have yet been clearly established for the HARDJACKET™, thus the inventor hereof has also determined a preliminary so called 1½-ton provision (plus, having a safety-margin factor of 160% for 24hrs. @ 40°-120°F), for versions of the product intended to provide its wearer general safety against trench cave-in environment hazard usage for example. An assembled product weight of under 10-lbs. is also considered a vital guideline factor

1 toward meeting prolonged user comfort; and a slight initial (upon sustaining the load) circumferential max.-deflection ($\frac{1}{4}$ -inch diametrically inward) is permissible.

Study of Fig.-2 further shows the CPS-type HARDJACKET™ clearly revealing the construction of the front 11 and rear 12 protective-panels, being similar in basic structural character but employing slightly different contouring as to better interface with the general
5 physiognomy of the human-torso's front and back. In as much as there is a considerable percentile variance encountered in the variety of human body shapes (I.E.- long-waisted/short-waisted, large-chested/small-chested(girth), trim-waisted/thick-waisted (girth), etc.). For most working applications, there is a need to promote ambient-air
10 circulation between the respective panels and the body of the wearer, thus a nominal interstitial space 36 of about $\frac{3}{4}$ -inch is desired; thereby enabling ambient-air to circulate through via various front and rear formed ventilation-apertures 20. Additionally, Fig.-2 shows how respective panel skins 14 and 15 are preferably formed accurately, whereby outer-skin substrate 15 is contoured to a generally tighter radius than its inward facing
15 counterpart 14. This resultingly tapered variation in core 16 thickness serves to achieve a form of variable beam thickness, which is an effective way of reducing bulk (approx. 1-in. min.-thickness) at the left and right lateral side regions of the HARDJACKET™, while maintaining the greater bulk of thickness in the central chest (approx. $1\frac{1}{2}$ -ins. max.-thickness) and back (approx. $2\frac{1}{2}$ -ins. max.-thickness) regions where a greater thickness
20 does not usually interfere much with one's working space. By way of structural comparison, one can perhaps best envision a truss-bridge structure, wherein the sidewalls rise to their greatest height mid-stream, tapering down substantially at their extreme opposite ends.

Reference to Fig.-3 reveals the composite structure in greater detail, wherein the
25 preferred dove-tail like girth-retention structure includes a vertical male-tongue entity 21 which swings horizontally (via hinge-axis 18 in Fig.-2) into the vertical female-slot formed by adjacent vertical-groove formation entities 22 and 22'. Holding the tongue-&-groove arrangement intimately together is the preferable arrangement of lateral cinching-straps 25
29 working in cooperation with conventional quick-release type strap buckles 25'. Note also

how the ventilation apertures 20 of the CPS-type protective-panels 14/14' are constructed with inwardly interfacing and abutting aperture flanges 14" (formed from outer-skin substrate 14) and 13" (formed from inner-skin substrate 13); thereby serving to maintain the structural integrity of the assembly. While shown here as a myriad closed-cell filling substrate, the panel core 15 can be made of any light-weight filling such as conventional honeycomb or geodesic-dome inter-structures capable of unitedly reinforcing the preferably KEVLAR® inner-skin 13 and outer-skin 14.

There remain subtle, however vital other differences which are to become herein more evident and understood as further important features; for example, Fig's.-4A&4B show a generic-varient embodiment referred to as the FTE-type HARDJACKET™, owing that it features a unique "fabricated-truss element" form of construction. Although it could be made in a 2-piece configuration hinging open according to Fig.-2, this 3-piece configuration hinges open upon opposite lateral vertical hinge-axes 41 and 41' as shown in Fig.-5, the advantage of double hinging enabling an optional girth-adjustment provision.

Once donned by wearer 47' (per Fig's.-4A/6A), one may readily regulate the degree of closure, achieved here by merely selecting one of preferably three different adjustment-bore settings, employing vertical-axes 33/33'/33" staged proximal the inboard terminus of protective-panel horizontal-rib 30', and in vertical-axis alignment with the key-bore 32 of horizontal-rib 31'. In Fig.-5 we observe that key-bore 32 has been aligned vertically with adjustment-bore 33, but selecting other bores 33'/33" would thereby regulate the protective-panel medial opening to facilitate a greater girth dimension; whereupon the latch-pin 32' is inserted vertically there through. This preferred type of locking-pin device is of the type often employed with a clevis, and features a convenient spring-loaded external button-plunger (a.) which is depressed by one's thumb to obtain release of partially protruding retention-ball (b.), in order to insert or extract the locking-pin shank from one of the slip-fitting adjustment-bores 33/33'/33" and coaligning key-bore 32. Accordingly, both horizontal-ribs 31/31' of protective-panel 11", and 30/30' of protective-panel 11', are to be made in this manner. The latch-pin 32' is usually connected to horizontal-rib 31' via a short lanyard (3-inch nylon cord, not shown) preventing

inadvertent loss.

Study of Fig.-5 also best conveys the exemplified truss-element structural principle, wherein for example in the fabrication of the component protective-panel 11"; main-truss members 34 & 34' are tack-welded to intersect upon horizontal-ribs 31/31'; as are various other structural elements such as vertical-stiffener member 38' vertical-rib 39", the upper-right armature, and a trunnion like outboard terminus associated with hinging-axes 41. This tack-welded aggregation preferably comprised of sheet-aluminum elements, is preferably then enmasse oven-brazed into a unified structurally very rigid light-weight final component. The substantially like elements of the corresponding left-side front protective-panel 11' is made in the same manner (the nomenclature-section identifies these near mirror-image elements); as are the likewise assembled elements associated with fabrication of the rear protective-panel component 12' which utilizes an undivided upper armature portion 27. With all three components, their armature portions serve to provide an extra amount of strength by virtue of the armature's thin sheet-metal (preferably aluminum, aircraft-fuselage like) stressed-skin quality. While the shoulder-strap suspension arrangement is similar to that shown with the CPS-type construction of Fig's-1A/1B, the mooring-slots 45 formed through the armatures 27/28'/28" preferably include a softer-plastic edging or the type having a C-shaped cross-section. As with the CPS-type embodiment of Fig.-2, it is desired to provide an ample amount of interstitial space 46 between wearer's upper-abdomen/thorax region 47 and the inward facing portions of the donned HARDJACKET™, as to promote the circulation of ambient-air.

Note also, in some cases it may be desirable to mix-and-match types of construction; that is, assemble a somewhat hybrid version of the HARDJACKET™, possibly employing a combination of both CPS and FTE types of construction. For example, a CPS-type rear protective-panel 12 may be provided with the opposed lateral hinge-axis 41/41' arrangement shown here with the FTE-type frontal protective-panels 11'/11"; or conversely, a design-engineer may prefer to employ but a single frontal protective-panel 11, and instead, constructed in the manner of the exemplified FTE-type structure, and in combination with a rear protective-panel 12 made according to CPS-type construction.

VI.) WHAT IS CLAIMED OF PROPRIETARY INVENTIVE ORIGIN IS:

★ 1.) A three-piece hardjacket personal-safety apparatus assembly to be worn for example where cave-in hazard exists, protecting wearer's upper-abdomen/thorax region from potential insidious compression-load suffocation until rescued; said apparatus comprising:

5 a rigid first/protective-panel means not intimately but proximally interfacing wearer's back region;

a rigid second/protective-panel means hingedly dependent from said first/protective-panel, while not intimately but proximally interfacing wearer's left-front upper-abdomen/thorax and left-underarm region;

10 a rigid third/protective-panel means hingedly dependent from said first/protective-panel, while not intimately but proximally interfacing wearer's right-front upper-abdomen/thorax and right-underarm region;

a comfortably flexible shoulder-suspension means arranged between said first/protective-panel and both said second/protective-panel and said third/protective-panel;

15 a girth-retention means, enabling wearer to rigidly secure the distally opposite circumferential terminus margins of said second/protective-panel to said third/protective-panel at the front vertical medial region, and conversely, said girth-retention means enabling wearer to manually detach said second/protective-panel from said
20 third/protective-panel, whereby wearer may hingedly swing-apart respective said second and third protective-panels as to extricate themselves from said hardjacket.

2.) The safety hardjacket apparatus according to Claim-1, wherein said first/protective-panel means is a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate.

3.) The safety hardjacket apparatus according to Claim-1, wherein said second/protective-panel means is a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate.

4.) The safety hardjacket apparatus according to Claim-1, wherein said third/protective-panel means is a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate.

5.) The safety hardjacket apparatus according to Claim-1, wherein said shoulder-suspension means is comprised of two woven-straps, one woven-strap extending over wearer's left-shoulder the other woven-strap extending over wearer's right-shoulder.

6.) The safety hardjacket apparatus according to Claim-1, wherein said shoulder-suspension means is comprised of a fabric-like one-piece shoulder garment including front medial left from right separation, the aftward left-portion of which extends up from the left upper region of said first/protective-panel and over wearer's left-shoulder down securely to said second/protective-panel, the aftward right-portion of which extends up from the right upper region of said first/protective-panel and over wearer's right-shoulder down securely to said third/protective-panel.

7.) The safety hardjacket apparatus according to Claim-1, wherein said first/protective-panel means is comprised of a composite polymer-resin structure having an outward-facing skin discrete from an inward-facing skin, and including a rigidly uniting light-weight core means permanently bonded there between said skins.

3.) The safety hardjacket apparatus according to Claim-1, wherein said second/protective-panel means is a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate.

4.) The safety hardjacket apparatus according to Claim-1, wherein said third/protective-panel means is a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate.

5.) The safety hardjacket apparatus according to Claim-1, wherein said shoulder-suspension means is comprised of two woven-straps, one woven-strap extending over wearer's left-shoulder the other woven-strap extending over wearer's right-shoulder.

6.) The safety hardjacket apparatus according to Claim-1, wherein said shoulder-suspension means is comprised of a fabric-like one-piece shoulder garment including front medial left from right separation, the aftward left-portion of which extends up from the left upper region of said first/protective-panel and over wearer's left-shoulder down securely to said second/protective-panel, the aftward right-portion of which extends up from the right upper region of said first/protective-panel and over wearer's right-shoulder down securely to said third/protective-panel.

7.) The safety hardjacket apparatus according to Claim-1, wherein said first/protective-panel means is comprised of a composite polymer-resin structure having an outward-facing skin discrete from an inward-facing skin, and including a rigidly uniting light-weight core means permanently bonded there between said skins.

inserted through both said key-bore and one of the selected adjustment-bores, thereby attaining a positive link-up of said second/protective-panel to said third/protective-panel.

13.) The safety hardjacket apparatus according to Claim-12, wherein said latch-pin is of the conventional bayonet-type.

14.) The safety hardjacket apparatus according to Claim-1, wherein said assembly includes an external slipover high-identity garment of brightly-colored loosely-woven fabric serving to generally block dirt from entering said proximal interfacing region between the wearer and said assembly.

☆ **15.)** A three-piece hardjacket personal-safety apparatus assembly to be worn for example where cave-in hazard exists, protecting wearer's upper-abdomen/thorax region from potential insidious compression-load suffocation until rescued; said apparatus comprising:

5 a rigid first/protective-panel means made from a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air is free to circulate, and not intimately but proximally interfacing wearer's back region;

 a rigid second/protective-panel means made from a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which
10 ambient-air is free to circulate, and hingedly dependent from said first/protective-panel, while not intimately but proximally interfacing wearer's left-front upper-abdomen/thorax and left-underarm region;

 a rigid third/protective-panel means made from a composite plurality of intersecting open truss-work like structural elements joined rigidly together, through which ambient-air
15 is free to circulate, and hingedly dependent from said first/protective-panel, while not intimately but proximally interfacing wearer's right-front upper-abdomen/thorax and right-underarm region;

18 a comfortably flexible shoulder-suspension means arranged between said
first/protective-panel and both said second/protective-panel and said third/protective-
20 panel;

a girth-retention means, enabling wearer to manually attach said second/protective-
panel rigidly with said third/protective-panel, thereby securing aggregate said protective-
panels proximally around themselves; and conversely, said girth-retention means enabling
wearer to manually detach said second/protective-panel from said third/protective-panel,
25 whereby wearer may hingedly swing-apart respective said second and third protective-
panels as to extricate themselves from said hardjacket.

16.) The safety hardjacket apparatus according to Claim-15, wherein said latch-pin is of the conventional bayonet-pin type.

17.) The safety hardjacket apparatus according to Claim-15, wherein said girth-retention means comprises a plural arrangement of incrementally spaced apart vertical adjuster-bores of common size rigidly mounted proximal inboard-margin of said third/protective-panel, and an oppositely interposing vertical key-bore of said common size rigidly mounted proximal the adjoining inboard-margin of said second/protective-panel; whereby said second and third protective-panels can be manually interposed one to the other until the most suitable girth sizing is realized, whereupon a vertical latch-pin is vertically inserted through both said key-bore and one of the selected adjuster-bores, thereby attaining a positive link-up of said second/protective-panel to said third/protective-panel.

18.) The safety hardjacket apparatus according to Claim-15, wherein said shoulder-suspension means is comprised of two woven-straps, one woven-strap extending over wearer's left-shoulder the other woven-strap extending over wearer's right-shoulder.

19.) The safety hardjacket apparatus according to Claim-15, wherein said shoulder-suspension means is comprised of a fabric-like one-piece shoulder garmet including front medial left from right separation, the aftward left-portion of which extends up from the left upper region of said first/protective-panel and over wearer's left-shoulder down securely to said second/protective-panel, the aftward right-portion of which extends up from the right upper region of said first/protective-panel and over wearer's right-shoulder down securely to said third/protective-panel.

★ 20.) A two-piece hardjacket personal-safety apparatus assembly to be worn for example where cave-in hazard exists, protecting wearer's upper-abdomen/thorax region from potential insidious compression-load suffocation until rescued; said apparatus comprising:

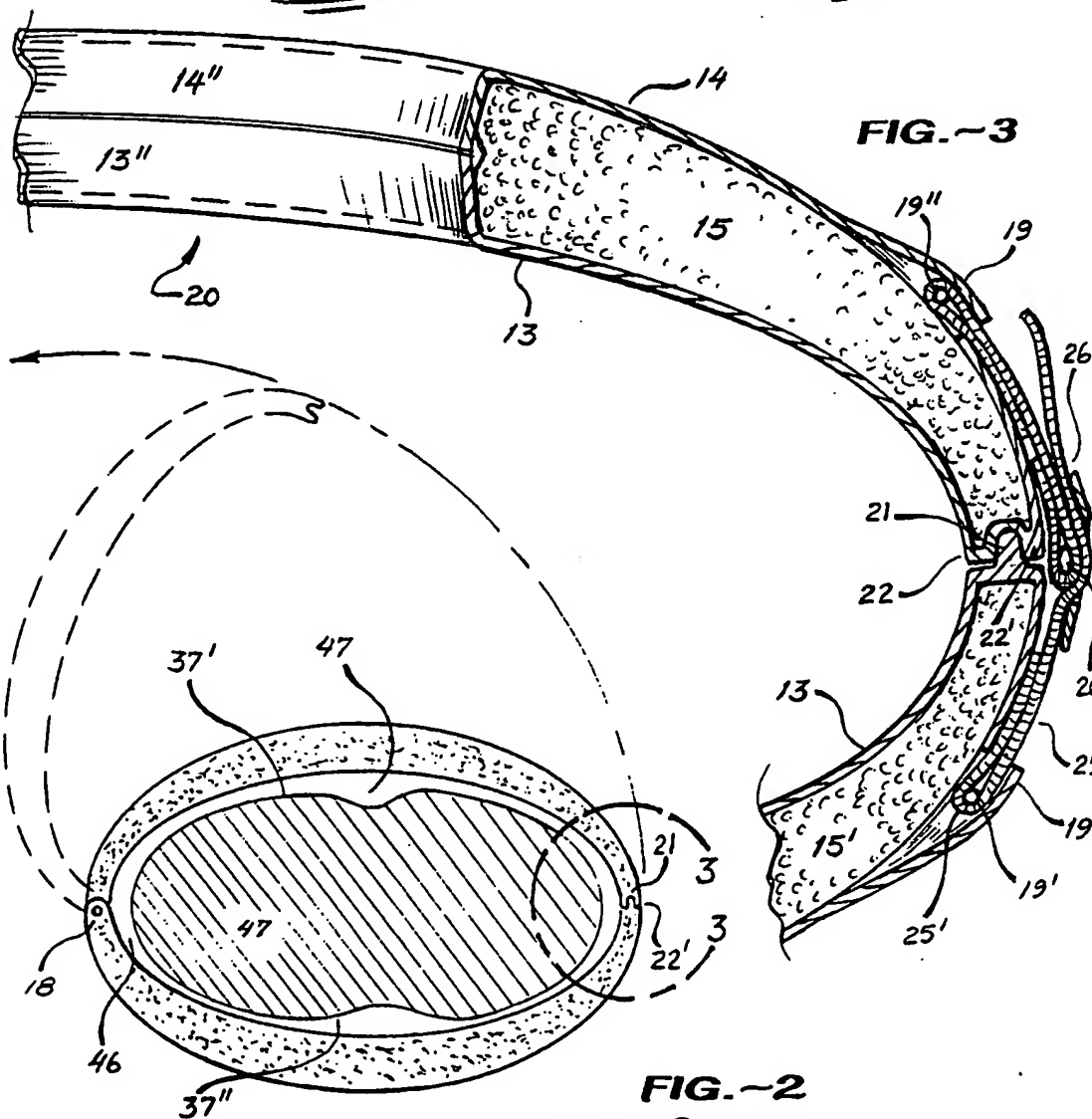
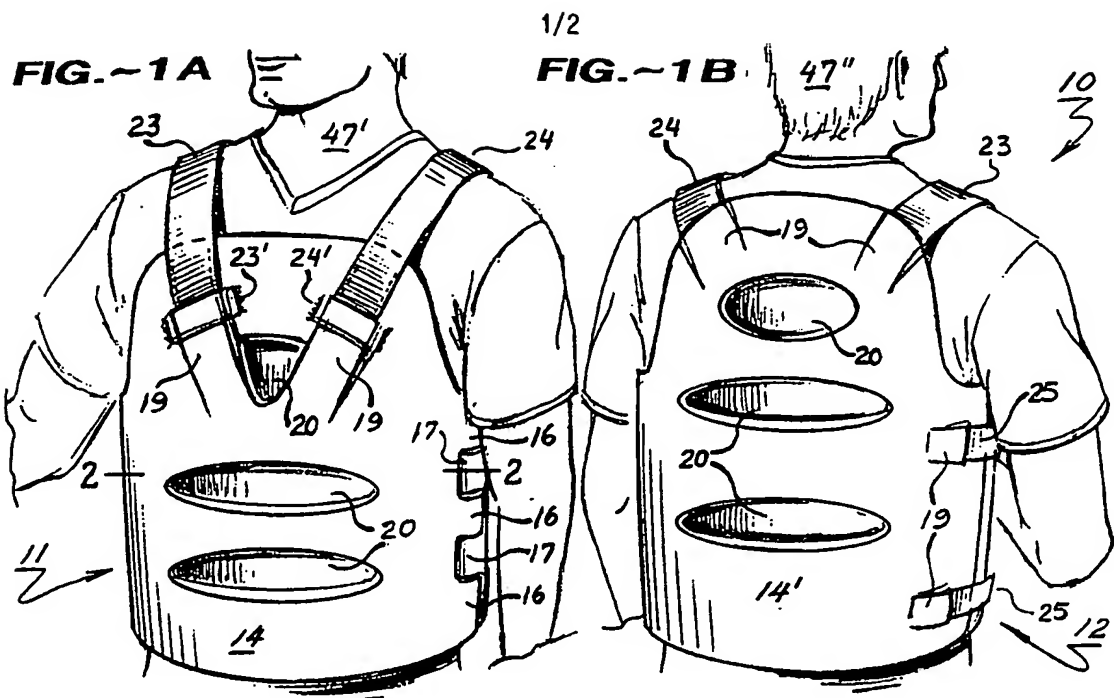
5 a rigid rear/protective-panel means not intimately but proximally interfacing wearer's back region;

a rigid front/protective-panel means hingedly dependent on one lateral side from said first/protective-panel, while proximally interfacing wearer's front-right and front-left upper-abdomen/thorax regions;

10 a comfortably flexile shoulder-suspension means arranged between said rear/protective-panel and said front/protective-panel;

a girth-retention means, enabling wearer to attach said rear/protective-panel rigidly to said front/protective-panel, thereby securing said hardjacket proximally around themselves; and conversely, said girth-retention means enabling wearer to manually detach **15** said rear/protective-panel from said front/protective-panel, whereby wearer may hingedly swing-apart respective said front/protective-panel from said rear/protective-panel as to manually extricate themselves from said hardjacket.

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